

WE CLAIM:

1. A method for selecting sensors from a sensor network for tracking of at least one target comprising the steps of:

- (a) defining an individual of a genetic algorithm construct having n chromosomes, wherein each chromosome represents one sensor ;
- (b) defining a fitness function based on desired attributes of the tracking;
- (c) selecting one or more of said individuals for inclusion in an initial population; and
- (d) executing a genetic algorithm on said population until defined convergence criteria are met, wherein execution of said genetic algorithm comprises the steps of:
 - (i) choosing the fittest individual from said population;
 - (ii) choosing random individuals from said population; and
 - (iii) creating offspring from said fittest and said randomly chosen individuals.

2. The method of claim 1, wherein said chromosomes representing said sensors comprise a binary or real number identification of said sensors.

3. The method of claim 1, further comprising defining an individual as comprising n chromosomes, wherein n is the number of sensors necessary to track said target multiplied by the number of said targets to be tracked

4. The method of claim 1, wherein said desired attributes of step (b) comprise minimal power consumption.

5. The method of claim 1, wherein said desired attributes of step (b) comprise minimal tracking error.

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6. The method of claim 1, wherein said desired attributes of step (b) comprise minimal power consumption and minimal tracking error.

7. The method of claim 6, wherein said fitness function of step (b) comprises the formula:

$$F = - \left(w_1 \sum_{i=1}^n E_i + w_2 \sum_{j=1}^m P_j \right),$$

wherein E_i ($i=1,2,\dots,k$) are the estimated position errors for tracking i^{th} target, wherein P_j ($j=1,2,\dots,m$) are the power consumption values of the j^{th} sensor; k is the number of targets; m is the total number of selected sensors, and w_1 and w_2 are two weight constants.

8. The method of claim 1, wherein said initial selection of said individuals in step (c) is accomplished by a random method.

9. The method of claim 1, wherein said convergence criteria of step (d) comprises a specified number of generations.

10. The method of claim 1, wherein said convergence criteria of step (d) comprises a specified number of generations after which no improvement is seen in the fittest individual in said population.

11. The method of claim 1, wherein said fittest individual of said population in step (d) is chosen based on said fitness function.

12. The method of claim 1, wherein said random individuals from said population in step (d) are chosen by roulette wheel selection, tournament selection, random number generation, or a combination thereof.

13. The method of claim 1, wherein said creation of said offspring in step (d) is accomplished by mutation, crossover, or combinations thereof.

14. The method of claim 13, wherein said creation of said offspring in step (d) occur through mutation, crossover, or a combination thereof, and only i chromosomes are affected during any one mutation or crossover, wherein i has a value of from 2 to $n-1$.

15. The method of claim 14, wherein i has a value of 2.

16. A method for selecting sensors from a sensor network for tracking of at least one target comprising the steps of:

- (a) defining an individual of a genetic algorithm construct having n chromosomes, wherein each chromosome represents one sensor;
- (b) defining a fitness function based on desired attributes of the tracking;
- (c) selecting one or more of said individuals for inclusion in an initial population; n
- (d) executing a genetic algorithm on said population until defined convergence criteria are met, wherein execution of said genetic algorithm comprises the steps of:
 - (i) choosing the fittest individual from said population; and
 - (ii) creating offspring from said fittest individual wherein said creation of said offspring occurs through mutation only, wherein only i chromosomes are mutated in one individual, and wherein i has a value of from 2 to $n-1$.

17. The method of claim 16, wherein said chromosomes representing said sensors comprise a binary or real number identification of said sensors.

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18 The method of claim 16, further comprising defining an individual as comprising n chromosomes, wherein n is the number of sensors necessary to track said target multiplied by the number of said targets to be tracked

19. The method of claim 16, wherein said desired attributes of step (b) comprise minimal power consumption.

20. The method of claim 16, wherein said desired attributes of step (b) comprise minimal tracking error.

21. The method of claim 16, wherein said desired attributes of step (b) comprise minimal power consumption and minimal tracking error.

22 The method of claim 21, wherein said fitness function of step (b) comprises the formula:

$$F = - \left(w_1 \sum_{i=1}^n E_i + w_2 \sum_{j=1}^m P_j \right),$$

wherein E_i ($i=1,2,...,k$) are the estimated position errors for tracking i^{th} target, wherein P_j ($j=1,2,...,m$) are the power consumption values of the j^{th} sensor; k is the number of targets; m is the total number of selected sensors, and w_1 and w_2 are two weight constants.

23. The method of claim 16, wherein said initial selection of said individuals in step (c) is accomplished by a random method.

24. The method of claim 16, wherein said convergence criteria of step (d) comprises a specified number of generations.

25. The method of claim 16, wherein said convergence criteria of step (d) comprises a specified number of generations after which no improvement is seen in the fittest individual in said population.

26. The method of claim 16, wherein i has a value of 2.

27. A method for selecting sensors from a sensor network for tracking of a target comprising the steps of:

(a) defining an individual of a genetic algorithm construct having n chromosomes, wherein each chromosome represents one sensor, wherein $n = k * y$ where k is the number of targets to be tracked and y is the number of sensors needed to track one target;

(b) defining a fitness function based on power consumption of said sensors and tracking errors made by said sensors;

(c) randomly selecting one or more of said individuals for inclusion in an initial population; and

(d) executing a genetic algorithm on said initial population until defined convergence criteria are met, wherein said convergence criteria are based on number of generations iterated in said genetic algorithm, wherein execution of said genetic algorithm comprises the steps of:

(i) choosing the fittest individual, based on said fitness function from said population; and

(ii) creating offspring from said fittest individual, wherein said creation of said offspring occurs through mutation only, and wherein only 2 chromosomes are mutated in one individual; and

(e) selecting sensors based on said individuals comprising the population that exists at the time when said defined convergence criteria are met.

28. A network of sensors for tracking objects comprising:

- N*
- (A) ~~a number, N~~ of sensors;
- (B) a controller capable of controlling and managing said *N* sensors, wherein said controller selects sensors from a sensor network for tracking of a target by carrying out a method comprising the following steps:
- (i) defining an individual of a genetic algorithm construct having *n* chromosomes, wherein each chromosome represents one sensor;
 - (ii) defining a fitness function based on desired attributes of the tracking;
 - (iii) selecting one or more of said individuals for inclusion in an initial population; *and*
 - (iv) executing a genetic algorithm on said population until defined convergence criteria are met, wherein execution of said genetic algorithm comprises the steps of:
 - (a) choosing the fittest individual from said population;
 - (b) choosing random individuals from said population; and
 - (c) creating offspring from said first and said randomly chosen individuals; *and*
- (C) a means for said individual sensors and said controller to communicate.

29. The network of sensors of claim 28, wherein said chromosomes representing said sensors comprise a binary or real number identification of said sensors.

30. The network of sensors of claim 28, further comprising defining an individual as comprising *n* chromosomes, wherein *n* is the number of sensors necessary to track said target multiplied by the number of said targets to be tracked

31. The network of sensors of claim 28, wherein said desired attributes of step (b) comprise minimal power consumption.

32. The network of sensors of claim 28, wherein said desired attributes of step (b) comprise minimal tracking error.

33. The network of sensors of claim 28, wherein said desired attributes of step (ii) comprise minimal power consumption and minimal tracking error.

34. The network of sensors of claim 33, wherein said fitness function of step (ii) comprises the formula:

$$F = - \left(w_1 \sum_{i=1}^n E_i + w_2 \sum_{j=1}^m P_j \right),$$

wherein E_i ($i=1,2,\dots, k$) are the estimated position errors for tracking i^{th} target, wherein P_j ($j=1,2,\dots,m$) are the power consumption values of the j^{th} sensor; k is the number of targets; m is the total number of selected sensors, and w_1 and w_2 are two weight constants.

35. The network of sensors of claim 28, wherein said initial selection of said individuals in step (c) is accomplished by a random method.

36. The network of sensors of claim 28, wherein said convergence criteria of step (d) comprises a specified number of generations.

37. The network of sensors of claim 28, wherein said convergence criteria of step (d) comprises a specified number of generations after which no improvement is seen in the fittest individual in said population.

38. The network of sensors of claim 28, wherein said fittest individual of said population in step (d) is chosen based on said fitness function.

39. The network of sensors of claim 28, wherein said random individuals from said population in step (d) are chosen by roulette wheel selection, tournament selection, random number generation, or a combination thereof.

40. The network of sensors of claim 28, wherein said creation of said offspring in step (d) is accomplished by mutation, crossover, or combinations thereof.

41. The network of sensors of claim 28, wherein said creation of said offspring in step (d) occur through mutation, crossover, or a combination thereof, and only i chromosomes are affected during any one mutation or crossover, wherein i has a value of from 2 to $n-1$.

42. The network of sensors of claim 28, wherein i has a value of 2.

43. A network of sensors for tracking objects comprising:

(A) ~~a number, N~~ of sensors;

(B) a controller capable of controlling and managing said N sensors, wherein said controller selects sensors from a sensor network for tracking of a target by carrying out a method comprising the following steps:

(i) defining an individual of a genetic algorithm construct having n chromosomes, wherein each chromosome represents one sensor;

(ii) defining a fitness function based on desired attributes of the tracking;

(iii) selecting one or more of said individuals for inclusion in an initial population; *and*

(iv) executing a genetic algorithm on said population until defined convergence criteria are met, wherein execution of said genetic algorithm comprises the steps of:

(a) choosing the fittest individual from said population; and

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- (b) creating offspring from said fittest individual wherein said creation of said offspring occurs through mutation only, wherein only i chromosomes are mutated during any one mutation, and wherein i has a value of from 2 to $n-1$; *and*
- (C) a means for said individual sensors and said controller to communicate.

44. The network of sensors of claim 43, wherein said chromosomes representing said sensors comprise a binary or real number identification of said sensors.

45. The network of sensors of claim 43, further comprising defining an individual as comprising n chromosomes, wherein n is the number of sensors necessary to track said target multiplied by the number of said targets to be tracked

46. The network of sensors of claim 43, wherein said desired attributes of step (ii) comprise minimal power consumption.

47. The network of sensors of claim 43, wherein said desired attributes of step (ii) comprise minimal tracking error.

48. The network of sensors of claim 43, wherein said desired attributes of step (ii) comprise minimal power consumption and minimal tracking error.

49. The network of sensors of claim 48, wherein said fitness function of step (ii) comprises the formula:

$$F = - \left(w_1 \sum_{i=1}^n E_i + w_2 \sum_{j=1}^m P_j \right),$$

wherein E_i ($i=1,2,\dots,k$) are the estimated position errors for tracking i^{th} target, wherein P_j ($j=1,2,\dots,m$) are the power consumption values of the j^{th} sensor; k is the number of targets; m is the total number of selected sensors, and w_1 and w_2 are two weight constants.

50. The network of sensors of claim 43, wherein said initial selection of said individuals in step (c) is accomplished by a random method.

51. The network of sensors of claim 43, wherein said convergence criteria of step (d) comprises a specified number of generations.

52. The network of sensors of claim 43, wherein said convergence criteria of step (d) comprises a specified number of generations after which no improvement is seen in the fittest individual in said population.

53. The network of sensors of claim 43, wherein i has a value of 2.

54. A network of sensors for tracking objects comprising:

(A) ~~a number, N~~ of sensors;

(B) a controller capable of controlling and managing said N sensors, wherein said controller selects sensors from a sensor network for tracking of a target by carrying out a method comprising the following steps:

(i), defining an individual of a genetic algorithm construct having n chromosomes, wherein each chromosome represents one sensor, wherein $n=k * y$ where k is the number of targets to be tracked and y is the number of sensors needed to track one target;

(ii) defining a fitness function based on power consumption of said sensors and tracking errors made by said sensors;

(iii) randomly selecting one or more of said individuals for inclusion in an initial population; and

(iv) executing a genetic algorithm on said initial population until defined convergence criteria are met, wherein said convergence criteria are based on number of generations iterated in said genetic algorithm, wherein execution of said genetic algorithm comprises the steps of:

(a) choosing the fittest individual, based on said fitness function from said population; and

(b) creating offspring from said fittest individual, wherein said creation of said offspring occurs through mutation only, and wherein only 2 chromosomes are mutated during any one mutation; and

(v) selecting sensors based on said individuals comprising the population that exists at the time when said defined convergence criteria are met; and

(C) a means for said individual sensors and said controller to communicate.

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